

Group-IV Spintronics

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Period of workshop, 2009.10.5-2009.10.6

1. Spintronics, which is a field of a fusion domain of semiconductor physics and magnetism, attracts enormous attention in several decades from standing points of basic science and applications. Currently, metallic and compound semiconductor (such as GaAs) spintronics play pivotal roles in a field of spintronics, however, spintronics using group-IV elements, such as carbon and silicon, is expected to be the third pillar in spintronics in recent several years. Realization of good spin coherence and its practical applications is strongly expected to “Group IV Spintronics”, which is one of the main reasons why people are attracted by this field, and for instance, spin transistors, novel magnetic sensors and quantum computation devices are thought to be realized. Although a limited number of reliable studies in carbon-based spintronics and difficulty in injecting spins into Si have been huge obstacles, recent progress and reliable studies allows us to think that this research field entered a new stage of science and to expect dramatic developments. Based on these backgrounds, we have determined targets of this workshop on; (1) presentation of the latest results on carbon- and silicon-based spintronics by outstanding international and domestic researchers, (2) emerging fruitful discussion, and (3) construction of strategy for further progress of group-IV spintronics.

2. We organized a two-day workshop in IMR, and invited 6 excellent special speakers from abroad and Japan, and also invited 11 invited speakers in Japan who are positioned at the cutting edge in this “Group IV Spintronics”. Each special speaker had one hour for his/her talk, and every invited speaker had twenty-five minutes for his talk. In addition, we organized a poster session in the afternoon of the second day, and in total 14 people, who are posdocs, company engineers and graduate school students, gave

presentations about their latest results.

3. The special talks covered broader ranges of the field. Prof. Moodera (MIT, USA) talked about his recent study on spin dependent tunneling via organic layers (rubrene and Alq₃), and also study on a spin filtering effect using oxide tunneling layers. Prof. Appelbaum (Univ. Maryland, USA) introduced spin injection, transport and precession measurements by using his excellent hot-electron transistor structures. Prof. Dediu (ISMN-CNR, Italy) talked about magnetoresistance in Co/Alq₃/LaSrMnO sandwiched spin valves and possible applications for sensors and multi-functional devices of the spin valves. Prof. Maekawa (Tohoku Univ. Japan) gave an overview of spin transport in condensed matters, including his latest findings, a spin Seebeck effect, and so on. Prof. Koehler (Univ. Bayreuth, Germany) introduced triplet state energetics and dynamics in organic and organometallic semiconductors and intrinsic magnetoresistance effects in organic molecules by using optical measurement techniques. Finally, Prof. Hu (Univ. Tennessee, USA) talked about magnetic field effects in various organic molecules. As described above, the contents of 4 of 6 special talks are molecular spintronics, that of 1 of 6 is silicon spintronics, and that of 1 of 6 is a general overview.

Concerning the invited talks, various topics were vigorously discussed; (1) Giant magnetoresistance in C₆₀-Co systems, (2) Spin crossover complex, (3) Magnetic photo current effects in organic photovoltaic devices, (3) FET-ESR characterizations using rubrene single crystal, (4) Spin injection into silicon by using Fe₃Si, (5) Spin injection and transport in graphene, (6) Organic radical electronics, (7) Exchange interaction between charge carriers in organic EL materials (8) Room temperature & giant magnetoresistance observed in low-doped silicon and (9) Dopant dependence of OMAR in photoconductive polyvinylcarbazole films.

4. Whereas this is, probably, the first international workshop on group-IV spintronics, participants exchanged fruitful discussions and discussed deep insight of physics in spin transport in molecules and silicon. In this sense, the purpose of this workshop was fully achieved, and it can be concluded that the workshop was successfully closed. After the workshop, many participants told the organizers that they are strongly looking forward to organizing the second workshop next year once again.

Program of the workshop:

Group IV Spintronics

Program

9:35 – 11:00 **Chairperson) M. Shiraishi (Osaka Univ.)**

J. S. MOODERA (MIT)

S. SAKAI (GENKEN)

11:20 – 12:35 **Chairperson) B. Hu (Univ. Tennessee)**

M. MATSUDA (Kumamoto Univ.)

H. TAJIMA (Univ. Tokyo)

K. MARUMOTO (Univ. Tsukuba)

13:55 – 15:45 **Chairperson) J. Moodera (MIT)**

I. APPELBAUM (Univ. Maryland)

K. HAMAYA (Kyushu Univ.)

K. KOBAYASHI (Kyoto Univ.)

16:10 - 17:35 **Chairperson) K. Hayama (Kyushu Univ.)**

V. DEDIU (ISMN-CNR, Bologna)

M. SHIRAISHI (Osaka Univ.)

Oct. 6th

9:00 - 10:25 **Chairperson) I. Appelbaum (Univ. Maryland)**

S. MAEKAWA (Tohoku Univ.)

A. KANDA (Univ. Tsukuba)

10:45 – 12:10 **Chairperson) T. Ikoma (Niigata Univ.)**

A. KÖHLER (Univ. Bayreuth)

K. AWAGA (Nagoya Univ.)

14:30 – 16:20 **Chairperson) M. Matsuda (Kumamoto Univ.)**

B. HU (Univ. Tennessee)

Y. SAKAGUCHI (RIKEN)

T. IKOMA (Niigata Univ.)